

Supplementary Material for Manuscript:



Muscle recruitment and coordination during upper-extremity functional tests

Supplement - Interactive Data Visualization

Our research team has compiled the results from this work into an interactive graphic interface using Tableau. We find this platform allows the reader to dive into the data, examine muscle-specific features, and compare across tasks to support the static figures in the manuscript. Since the on-line interface does not currently allow for interactive graphics in the review process, we have created this guide to share the data visualization. Upon acceptance, this visualization would be published on the University of Washington Public Tableau Server.

The following display screenshots of the interface that users will experience, page by page. The interactive visualization follows the progression of the current results section: beginning with performance, recruitment, and coordination outcomes for the Jebsen Taylor Hand Function Test (JTHF), then Chedoke Arm and Hand Assessment Inventory (CAHAI – 13), and Box and Block Test (BBT).

Users will be able to select and highlight muscles, tests, compare dominant to non-dominant limbs and dive deeper to select individual subjects and assess the linear envelopes on a muscle-by-muscle and task-by-task basis.

The  icon is used to demonstrate information that appears when a reader hovers their mouse over data or clicks on a muscle or muscle pairing to highlight specific features on a figure. The  icon and **red text** on the following story pages are in addition to what readers would experience. They are meant to help the readers of this static format understand the interactive nature.

Muscle Recruitment and Coordination

<	Introduction	JTHF: Performance	JTHF: Recruitment	JTHF: Rec. Heat Map	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------	-------------------	-------------------	---------------------	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	-------------------	------------------------	---

Muscle recruitment and coordination during upper-extremity functional tests

Welcome to our interactive data visualization page. We invite you to use the bar at the top of your page to scroll through the performance, recruitment, and coordination results for the *Jebsen Taylor Hand Function Test (JTHF)*, the *Chedoke Arm and Hand Assessment Inventory (CAHAI)*, and the *Box and Blocks Test (BBT)*. The figures you find on the following pages are meant to be supplementary to our paper (FUTURE LINK) by providing an in depth look at our data, and allows the user to "Plug and Play" by selecting specific muscles, limb dominance, tasks, and subjects. Hovering over charts with your mouse will also provide detailed information.

Keshia M. Peters¹, Valerie E. Kelly², Tasha Chang², Madeline C. Weismann², Sarah Westcott-McCoy², Katherine M. Steele¹

¹ Mechanical Engineering, University of Washington, Seattle, WA

² Rehabilitation Medicine, University of Washington, Seattle, WA

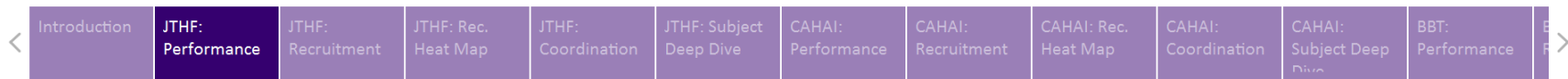
Corresponding Author:

Katherine M. Steele

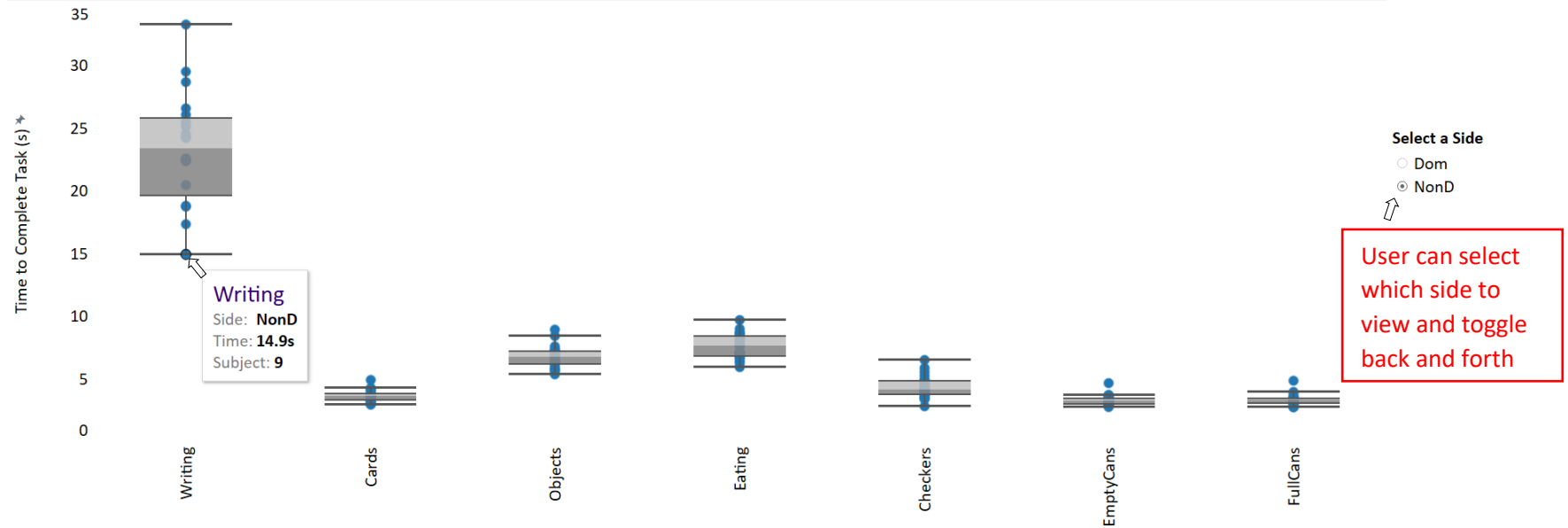
Mechanical Engineering, University of Washington

Stevens Way, Box 352600 ..

Muscle Recruitment and Coordination



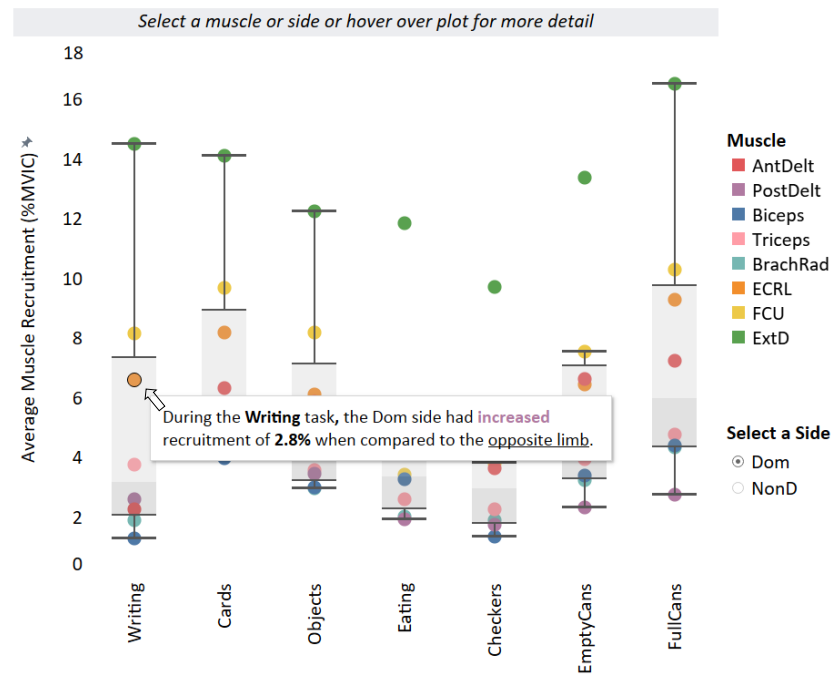
Select a side on the right or hover your mouse over plot for details



The **Jebsen-Taylor Hand Function Test (JTHF)** measures performance based on time to complete a tasks, unilaterally.

Muscle Recruitment and Coordination

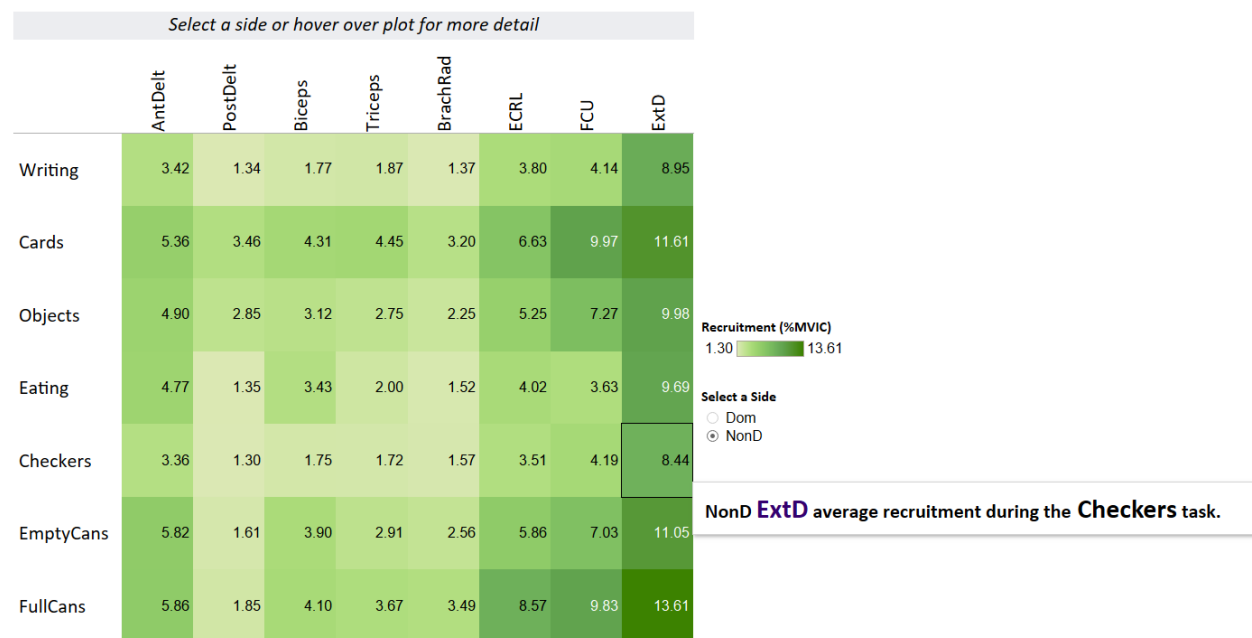
<	Introduction	JTHF: Performance	JTHF: Recruitment	JTHF: Rec. Heat Map	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	B	>
---	--------------	-------------------	-------------------	---------------------	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	---	---



Muscle recruitment averaged across participants for each subtask.

Muscle Recruitment and Coordination

<	Introduction	JTHF: Performance	JTHF: Recruitment	JTHF: Rec. Heat Map	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	B	>
---	--------------	-------------------	-------------------	----------------------------	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	---	---

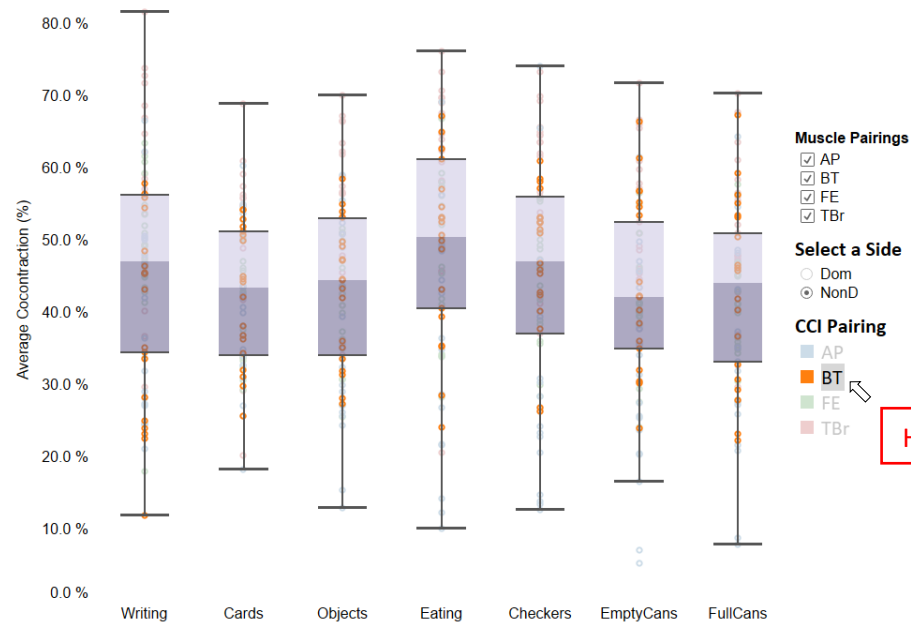


This heat map displays average muscle recruitment as a gradient, with greater levels of recruitment displayed in darker shades.

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	-------------------	------------------------	---

Select one or more muscle pairings, select a side, and hover over plot for more detail

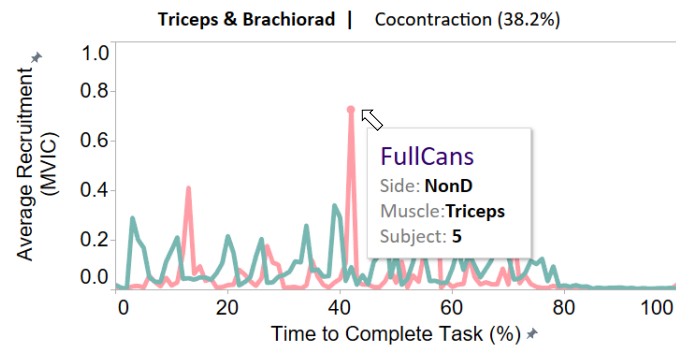
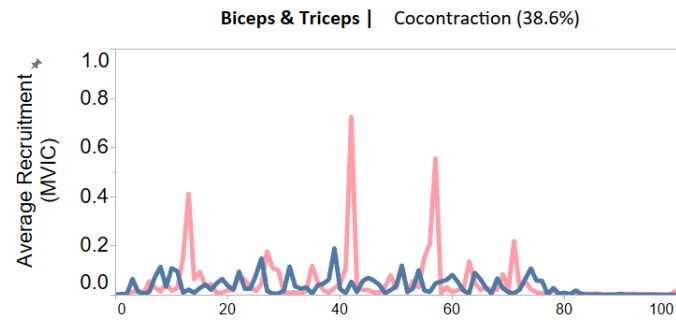
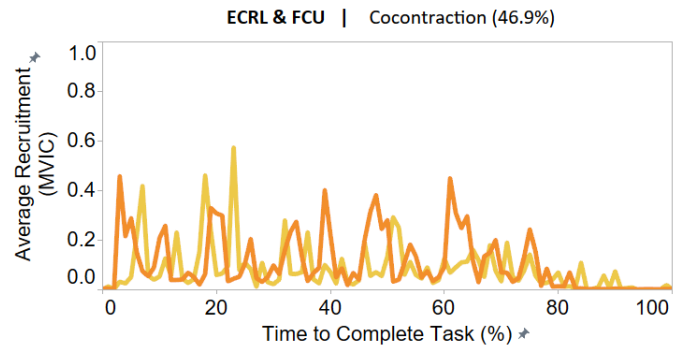
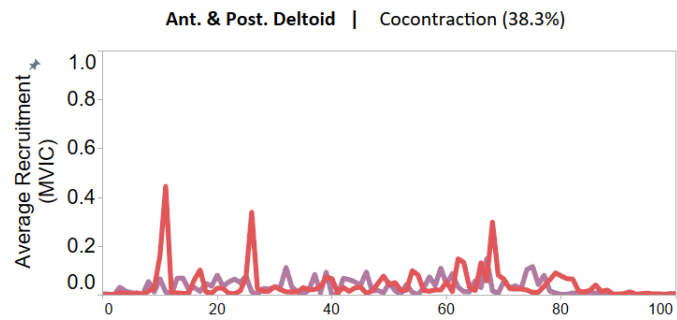


Each participant's cocontraction for each muscle pairing across tasks.

Muscle Recruitment and Coordination



Select a Side, Subject, and Task to deep dive into individual and task specific recruitment profiles



**Plug and Play
JTHA Tasks:**

Select a Side

- ☐ Dom
- ☒ NonD

Select a Subject

5

Select a Task

FullCans

Muscle

- AntDelt
- PostDelt
- Biceps
- Triceps
- BrachRad
- ECRL
- FCU

FullCans
Side: **NonD**
Muscle: **Triceps**
Subject: **5**

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	---------------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	-------------------	------------------------	---

Chedoke Arm and Hand Assessment Inventory (CAHAI)

The CAHAI version 13 was modified to include the following 12 tasks:

1. Open a jar of coffee
2. Dial a Phone
3. Draw a line with a ruler
4. Pour a glass of water (enough water to fill cup 3/4 full)
5. Wring out washcloth
6. Do up five buttons
7. Dry back with towel
8. Put toothpaste on toothbrush
9. Cut medium resistance putty
10. Zip up the zipper
11. Clean a pair of eyeglasses
12. Place container on table

Performance

The CAHAI is evaluated on the following activity scale:

1. total assist (weak U/L <25%)
2. maximal assist (weak U/L = 25-49%)
3. moderate assist (weak U/L = 50-74%)
4. minimal assist (weak U/L > 75%)
5. supervision
6. modified independence (device)
7. complete independence (timely, safely)

All unimpaired participants scored a 7 on each task, showing complete independence.

Muscle Recruitment and Coordination

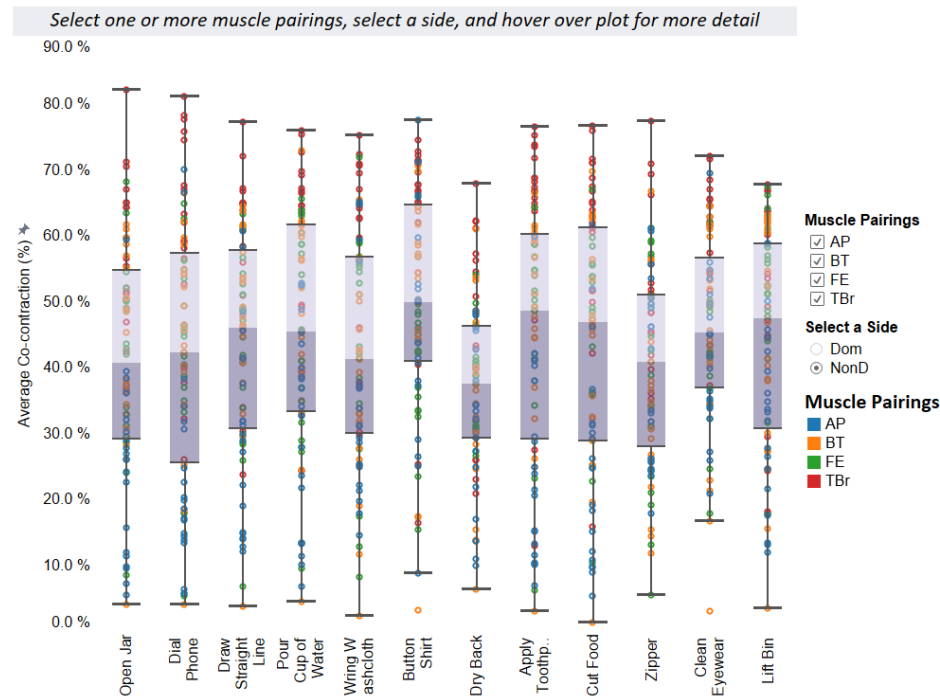


Muscle Recruitment and Coordination

	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive
	AntDelt	PosDelt	Biceps	Triceps	BrachRad	ECRL	FCU	ExtD	Recruitment (%MVIC) 0.60 13.25 Select a Side <input type="radio"/> Dom <input checked="" type="radio"/> NonD			
Open Jar	8.67	0.79	3.39	2.02	1.72	4.58	4.54	10.04				
Dial Phone	7.60	0.68	2.42	1.83	1.43	3.48	2.91	8.71				
Draw Straight Line	5.28	1.11	2.02	2.29	1.02	2.73	6.27	7.81				
Pour Cup of Water	5.96	0.60	2.86	1.46	1.15	2.74	1.53	6.17				
Wring Washcloth	8.74	1.47	8.24	3.08	2.53	6.40	11.35	12.14				
Button Shirt	2.03	1.07	3.43	1.98	2.30	4.32	3.66	7.34				
Dry Back	7.51	4.58	3.49	4.87	2.43	7.04	5.44	10.79				
Apply Toothpaste	7.29	0.76	3.11	1.59	1.38	3.90	3.68	8.12				
Cut Food	6.00	0.72	3.52	1.60	1.63	4.35	3.55	9.73				
Zipper	4.53	2.90	2.17	3.97	2.22	6.12	10.79	13.25				
Clean Eyewear	2.67	1.34	3.22	2.69	2.16	6.27	5.11	11.99				
Lift Bin	3.94	0.97	6.95	2.18	4.56	7.96	5.68	7.75				

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	-------------------	------------------------	---

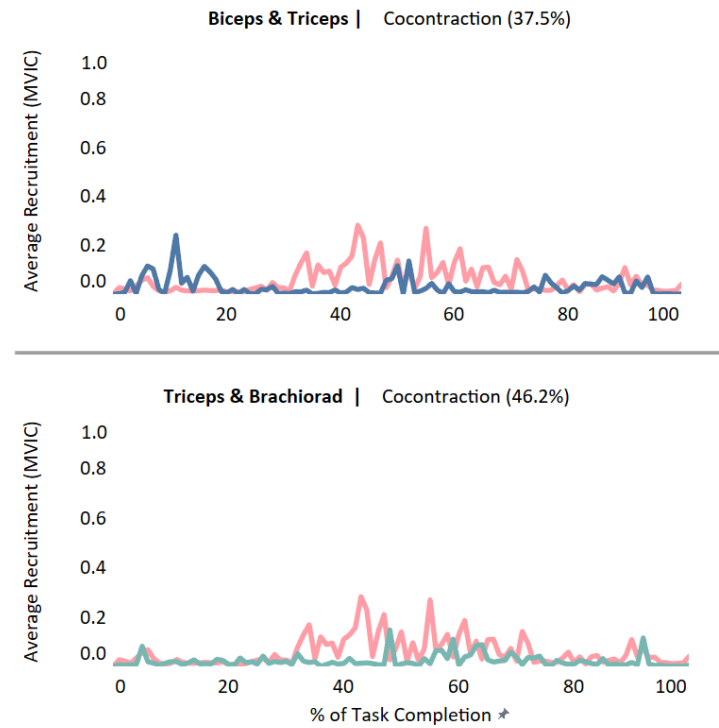
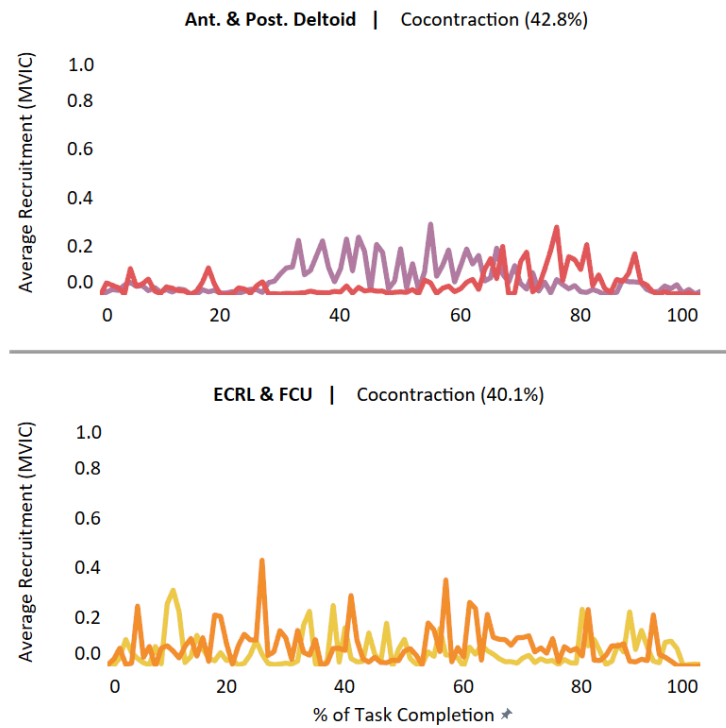


Each participant's cocontraction for each muscle pairing across tasks.

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	-------------------	------------------------	---

Select a Side, Subject, and Task to deep dive into individual and task specific recruitment profiles



Plug and Play CAHAI Tasks:

Select a Side

- ☒ Dom
☐ NonD

Select a Subject

9

Select a Task

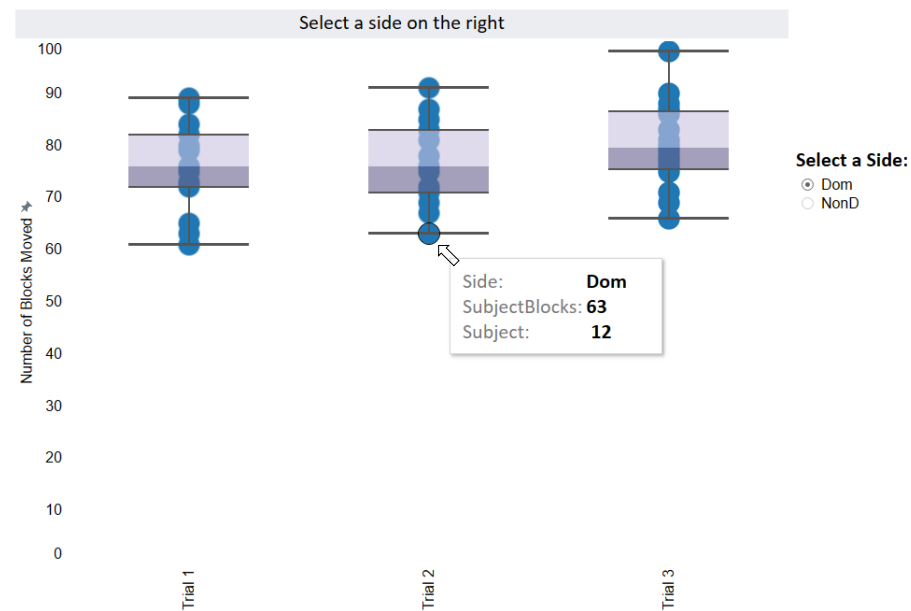
Dry Back

Muscle

- AntDelt
- PostDelt
- Biceps
- Triceps
- BrachRad
- Triceps
- ECRL
- FCU

Muscle Recruitment and Coordination

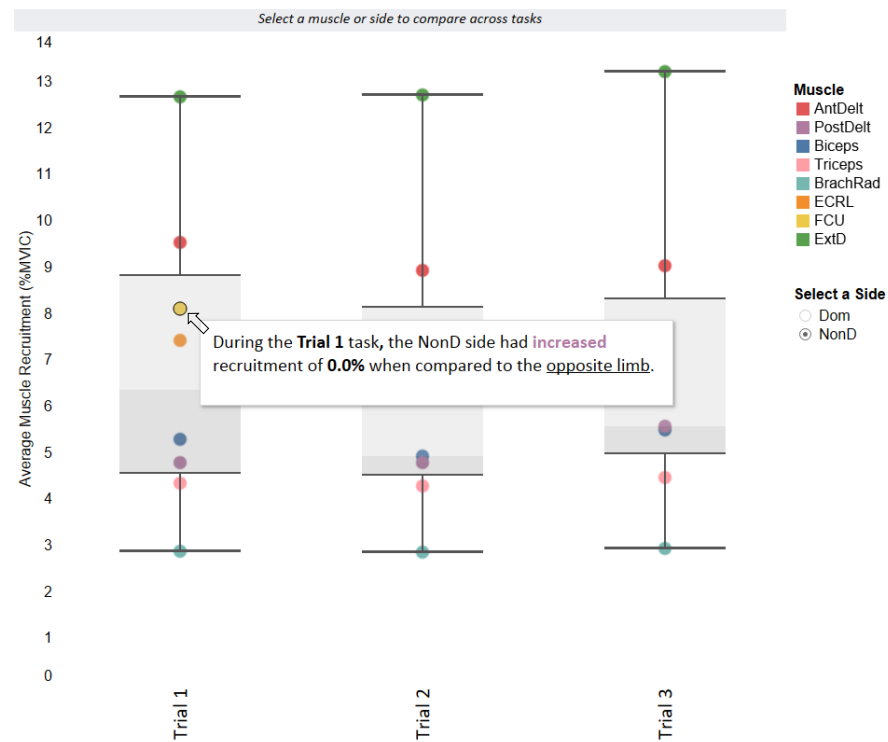
<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	-------------------------	------------------	--------------------	-------------------	------------------------	---



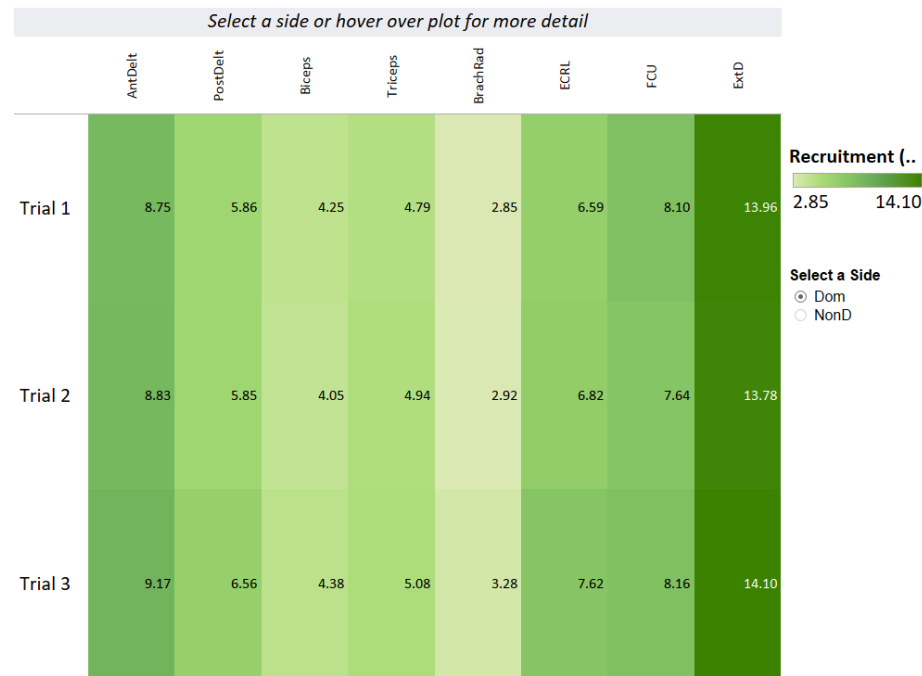
Performance for the Box and Blocks is quantified by the number of blocks moved within the span of 1 minute.

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	-------------------------	--------------------	-------------------	------------------------	---



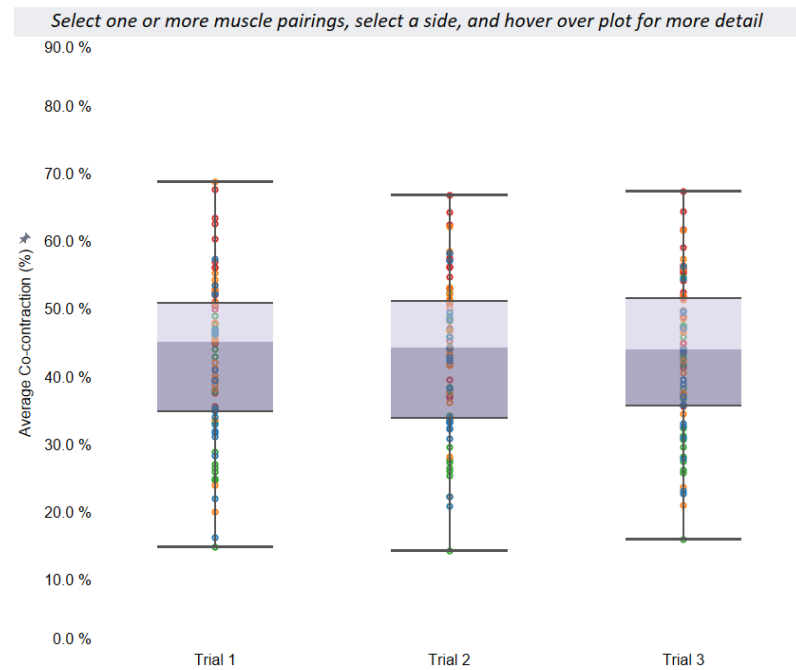
Muscle Recruitment and Coordination



This heat map displays average muscle recruitment as a gradient, with greater levels of recruitment displayed in darker shades.

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	--------------------------	------------------------	---

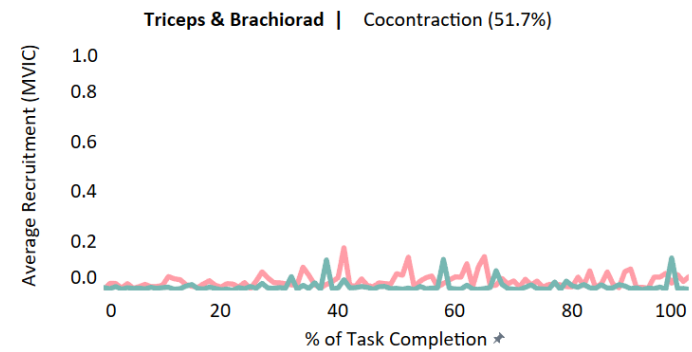
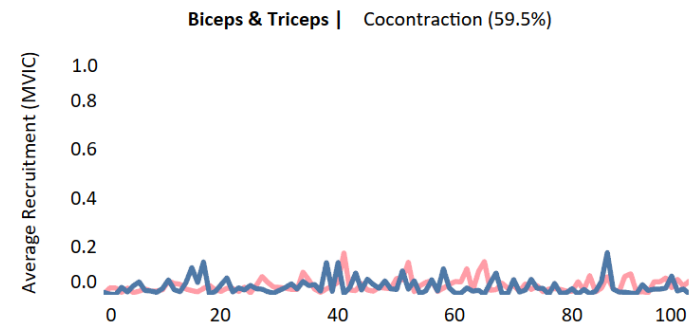
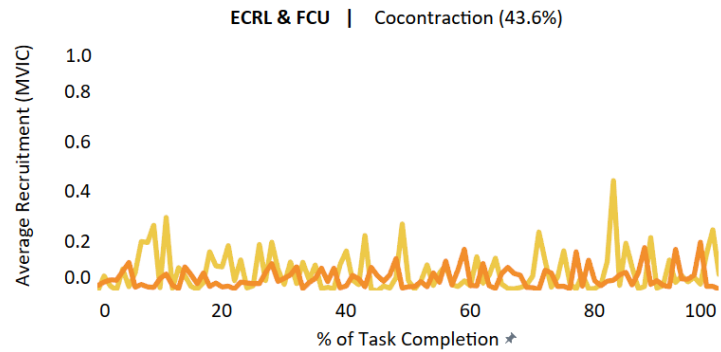
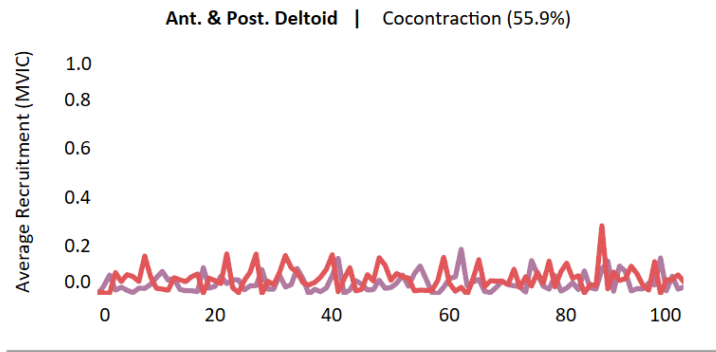


Each participant's cocontraction for each muscle pairing across tasks.

Muscle Recruitment and Coordination

<	JTHF: Coordination	JTHF: Subject Deep Dive	CAHAI: Performance	CAHAI: Recruitment	CAHAI: Rec. Heat Map	CAHAI: Coordination	CAHAI: Subject Deep Dive	BBT: Performance	BBT: Recruitment	BBT: Rec. Heat Map	BBT: Coordination	BBT: Subject Deep Dive	>
---	--------------------	-------------------------	--------------------	--------------------	----------------------	---------------------	--------------------------	------------------	------------------	--------------------	-------------------	------------------------	---

Select a Side, Subject, and Task to deep dive into individual and task specific recruitment profiles



Plug and Play Box and Blocks:

Select a Side

- ☒ Dom
- ☐ NonD

Select a Subject

9

Select a Trial

Trial 2

Muscle

- AntDelt
- PostDelt
- Biceps
- Triceps
- ECRL
- FCU
- BrachRad
- Triceps